

- X. *Progressive melanism on the Riviera (Hyères), being further notes on *Hastula hyerana*, Mill.* By T. A. CHAPMAN, M.D.

[Read March 21st, 1906.]

PLATE VIII.

MERELY as further notes on the life history of *Hastula hyerana*, Mill., the following facts would hardly have been worth presenting, as an addition to the account of the species I presented in the Entomologist's Monthly Magazine for 1905. Their value appears to lie in the further light they throw on melanism in the species at Hyères, and raise to something like certainty, what was last year little more than a suggestion, that melanism is a decided feature of the species at Hyères at present, though fifty years ago there was no trace of it. That melanism really exists in the Hyères race of *H. hyerana* is shown by Mr. Powell having reared 10 specimens at Hyères, of which 4 were dark, whilst from 10 larvæ collected at the same time which he sent to me in cocoon, and which were kept till emergence in England, only 2 dark specimens appeared, the other 8 being of the pale (typical) form. This seems to show clearly that the dark specimens I reared are naturally melanic, and are in no way artificial results of removal to the English climate. That such removal has no such effect is also proved by the breeding at Reigate of specimens of *H. hyerana*, from larvæ collected in Sicily, every one of which was of the typical pale form, with a good deal of variation in dark marking, but with no trace whatever of the melanic form. These Sicilian specimens resembled very much the typical (pale) Hyères form, so much so that, omitting a few of the more marked varieties, they are probably a fair representation of the Hyères examples bred fifty years ago by Milliere. I obtained also some larvæ from the Island of Capri; these produced moths of a very pale straw tint, with pale straw-coloured hind wings, possessing only a trace in one or two, of the fuscous tint that is the

(not quite invariable) rule in the Sicilian examples and the pale ones from Hyères.

I suppose I ought to make some effort to explain why *H. hyerana* should in fifty years have acquired and developed a melanic tendency. The probability seems to be, in reality, that the change has occurred in a considerably shorter time, but this is mere surmise, founded on the belief that *H. hyerana* has during that interval been collected at Hyères, and that no record, so far as I can find, exists of the melanic form having been observed. As a matter of fact, however, I am aware of no records of such captures at Hyères, but this is not perhaps surprising, as no melanic form occurring, the collector had little to add to Milliere's account and so published nothing. My friend M. I. Bourgeois on one occasion bred one or two pale ones, without making any record of the fact anywhere. We must, nevertheless, stick to the fifty years as the period during which the change has taken place. It is, no doubt, highly probable that a long period might elapse before the effective cause, whatever it was, accumulated sufficient effect to produce one or a few dark specimens; but thereafter the change by which about two-fifths of the race became dark was probably fairly rapid. It will be interesting to know whether a few more years produce any further effect, or merely confirm the present position.

What has produced the melanism? Hyères is doubtless a larger place than it was fifty years ago, and therefore more urban; but that that change has been accompanied by the very slightest appreciable change towards making it a smoky district with natural objects blackened, has only to be mentioned to raise a smile at the absurdity of the idea. I think we may therefore reject any trace of identity in causation, with those cases where, in England, urban increase and manufacturing activity are the basal causes of melanic change. I am not aware that there is the slightest evidence that Hyères is a wetter locality of late years than it used to be. Nevertheless there may be something in the circumstance that the rainy season at Hyères is in the autumn when the moth is on the wing, although this has always been the case no doubt, and is also a climatic feature, more or less, of the whole area of distribution of the moth.

The special fact that seems to me to throw most light on the matter is that *H. hyerana* has its head-quarters in

South Spain, North Africa, Southern Italy, Sicily, etc., and that Hyères is the extreme northern limit of its range. I pointed out in my previous notes how restricted the habitat of *H. hyerana* is on the Riviera, and that it is quite absent from many places, apparently suitable to it, as regards food-plant, etc. These places, however, are all of fractionally more northern climate than Hyères, which has the mildest climate of any French station west of Marseilles. This slight difference in climate between Hyères and the Riviera further east is probably the efficient cause of its localization to that one spot. How does this affect the matter? I do not desire to suggest that the northern position is the cause of the melanism, I do not think I should agree with the arguments likely to be adduced in support of such a contention. My suggestion amounts to this, that fifty years ago *H. hyerana* was a recent immigrant at Hyères, possibly for the first time, more likely it had previously established itself there on several occasions, but the locality being at the northern limit of its distribution, a few adverse, or even one very bad season might suffice to destroy it, and its place would be vacant until the arrival of individuals from some other locality. The new arrival would multiply in the form it had maintained in the locality it came from, until, after a sufficient lapse of time, it was modified to suit Hyères conditions. I suppose then that Milliere found it unmodified, but that now it has a form adapted to Hyères conditions. If the hypothesis of occasional extinction at Hyères be accepted, it might no doubt equally be suggested, that the species has disappeared during the last fifty years and the present form is the result of new arrivals (*marginata* occurs at Gibraltar), or such arrivals may have produced the change without the original race having disappeared. The objection to this is that it seems to postulate immigration, say, probably about every twenty-five years, whereas, change during the past fifty years postulates it, say, only once in about a hundred years, or more. The mixed melanic race would thus be the one suitable to Hyères, probably owing to the nature of the objects on which the moth would rest. The Capri form being so much paler than the Sicilian, would appear to prove that the dominating influence was not climate but locality. I advance this hypothesis simply because it seems incumbent on me to produce some sort of a rushlight to illuminate the way of further inquiry. The real interest of the case

rests on the possibility that it may assist in elucidating those instances of British melanism that seem outside the main stream, due to darkening of objects by deposited carbon.

In the imaginal state the three races I have (the fourth from Paestum is very close to that from Capri, but being represented by only one specimen does not admit of further discussion) differ materially from each other. The Capri race, of which I have 12 specimens, are very pale, var. *pallens*, of a very light straw colour, and the hind wings with no dark suffusion, are almost to be called white, the black spot very small, about normal in one specimen, and curiously even a little extended in another, which is otherwise one of the whitest. The Sicilian race, of which I have about 170 specimens, is decidedly darker than those from Capri. About 16 or 17 (10 %) are practically indistinguishable, but the majority have the hind wings fuscous and the fore wings a darker straw colour, *i.e.* with just a trace of orange. The greater part of these are paler than the similar form from Hyères, there is, however, one Hyères specimen (at least) that would mix indistinguishably with them. A further but very small number make a fair approach to what may be called the ordinary or typical Hyères form, which is at once rather redder and greyer than the mass of the Sicilian.

Then there are a certain number that present variation in the black markings, the tendency is rather (as compared with Hyères specimens) to smallness of the black spot, and a few have it absent or represented by an odd scale or so only. These are not necessarily the palest specimens, one with perhaps the least trace of spot (if any) is one of the darker orange specimens. The lighter and least spotted specimens are more numerous amongst the females.

There are only about 6 specimens (4 %) showing extension of the black spot; whilst about 20 % (of the pale form) from Hyères show this variation.

Hardly any show the row of dark points along the inner margin, and a smaller proportion show the dark scaling over the wing that usually takes the form of dots on the outer part of the wing, but several exceed in this respect any I have from Hyères (figs. 7 and 8), with black markings distributed over the whole wing; probably the larger number of specimens present the greater range of variation.

These dark spotted forms bring us to consider a point that did not clearly arise on the Hyères specimens. It may perhaps be best formulated by saying that the species has two directions in which it becomes darker, and these spotted specimens are the extremes I have in the direction of an increase of *black* scales. The other tendency does not exist apparently in the Italian forms; this is a tendency, not to black scales appearing, but to the yellow scales changing their tint to orange and then to deep purple, not in spots and patches like the black scales appear in, but by gradual change of all the scales, or more usually by the appearance of the purple scales singly scattered amongst the others. In describing my Hyères specimens I stated there were no intermediates between the pale and the dark, at least to this extent, that each specimen was at once referred either to light or dark, without hesitation. This, however, true as it may be, misrepresents the facts. Setting aside the pale Hyères forms, which, though darker on the average, might be matched from amongst the Sicilian forms, there are a considerable proportion of the pale forms that cannot be matched amongst Taormina forms, and, though pale, and though I so regarded them, really belong to the dark purple variety (*marginata*, Wlsm.). These number 8 out of 26 of my original specimens, 1 out of 8 of 1905 specimens, and 4 out of 14 of the Reigate bred specimens of 1905. These differ from the other pale ones by the presence of some purple scales over the wings (a somewhat indefinite character, that I have rather, therefore, neglected, and which may exist to some extent on those I have classified as pale) but especially (because easily noted) by a narrow line of red or purple scales down the middle of the costal fringe, more marked apically. This line is very distinct in every specimen of var. *marginata*, except one or two in which the dark disc of the wing almost reaches and absorbs it. I presume the yellow fringe, with this fine line, round the dark wing, suggested the name *marginata*. I would suggest that the typical point is really this fine line, and would regard it rather than the yellow fringe as the margin, so as to bring into the name *marginata* those pale forms possessing this line and that belong more truly to the dark than the pale series. It might perhaps be convenient to give these a separate name, say *marginula*.

The present proportion of *marginata* + *marginula* at

Hyères is 65 %. No trace of either of these occurs in the Italian races. Nor does Milliere record the slightest trace of them (and he was rather keen on variations) amongst over 50 specimens bred from Hyères fifty years ago. Without subdividing and naming aberrations on the *cristana* and *hastiana* system, it may be useful to give names to the principal forms.

The typical form *Hyerana*, Mill., would be characterized as having lighter or darker straw-coloured upper wings with black discal spot and little or no black scaling, and the disc of the hind wings more or less fuscous. This would include the whole of the species as known to Milliere and the species as a whole as it exists in Sicily. As aberrations of this we should have Milliere's var. *a*, *hyerana*, ab. *alpha*, Mill., with greater or less spreading of the discal spot; *hyerana*, ab. *nigro-punctata*, n. ab., with more or less conspicuous black scaling in dots and spots; *hyerana*, ab. *obsolescens*, n. ab., with the discal spot reduced to a scale or two or absent.

The very pale race at Capri would be *hyerana*, var. *pallens*, n. var., characterized by general lightness of the tint of the upper wings, and especially by the pale hind wings, with no fuscous tinting.

This form may occur as an aberration of the type form, and may present as aberrations ab. *alpha* and ab. *obsolescens*.

Then we have var. *marginata*, Wlsm. This is clearly not a mere aberration of the type form, but is trying to establish itself as a distinct race at Hyères by swamping and ousting the type, which it is very possible it has done at some other locality or period. This has the aberration *marginula*, n. ab., with the general aspect of a richly or darkly coloured type specimen but possessing the fine red line in the fringe. It may be regarded as an aberration either of *hyerana* or *marginata* or as a cross between them. To be an aberration of *hyerana*, however, its absence from Sicily makes its claims very doubtful.

The habits of the larva of *H. hyerana* at Taormina differed remarkably from those of the same species at Hyères; so much so, that at first, when the larvæ I found were small, I confess I had some doubts as to their being some other species, *unicolorana* perchance (I may here mention that I found no trace of *unicolorana* at Taormina). The great point of difference in habit was that instead of being numerous on a plant, almost gregarious as at Hyères,

they were almost absolutely solitary, one to a plant. Their position in the plant was amongst the central leaves rather low down, different from that of *T. unicolorana*, which occupies and remains in the tips of the older leaves and is fairly conspicuous in consequence. Very occasionally two larvæ were found in a plant, and on one occasion only did I find four larvæ in a plant. A marked result of this variation in the habits of the larva is that, whilst at Hyères an affected plant was conspicuous at some distance, and "wrecked" and "destroyed" were words one naturally employed to describe the effect on the foliage and inflorescence of the plant, at Taormina a plant containing a larva differs at first view in no way from one without one, and it is only on closer scrutiny and usually after moving the leaves a little, that one finds some of the central ones to be suspiciously close together as an indication that a larva is present. I am not inclined to think these differences have much to do with accidental differences of season, but that they are the normal habits of the species at the two localities; probably due to the different effect of the local climates on the food-plant. The Taormina asphodel seems to be the *A. microcarpus*, the same as that at Hyères, but the aspect of the plants regarded as vegetables is considerably different. At Hyères most plants were large, vigorous and succulent, two feet or more high (three or four sometimes), with great bundles of thick leaves, affording abundant food for a dozen or more larvæ. At Taormina I only saw two or three such plants, growing in favoured damp situations, and on these and others nearly as vigorous I saw no larvæ of the Tortrix. The mass of the plants are about fifteen to eighteen inches high with few leaves, and a very small proportion attempt to flower. On one slope on April 8th, when only about a third of the larvæ had done feeding, these stunted plants were already dying down from maturity or drought. On the other hand, these stunted plants are often very abundant and tolerably close together.

It was puzzling to understand how a moth could survive who laid her eggs in large batches, and yet only supplied each plant with one larva.

It is still rather a puzzle to see how one larva only exists in each plant, but there can be little doubt that as soon as the young larvæ are hatched, they exercise an

instinct that gave me trouble enough when I reared them from the egg, viz. a determination to wander away, in spite of all obstacles, getting through the finest crannies, and going too far to be recaptured. I found the most practicable method of preventing their dispersion was to put the vessel containing the eggs in the middle of a vessel of water, on which all the young larvæ would be found floating (in a mass usually) and could be put on their food. No doubt at Taormina by this wandering a batch of eggs provided larvæ that spread over a whole patch of asphodel, though how one, and one only, stuck to each plant is difficult to guess.

In this way one easily accounts for finding a larva in nearly each plant at one place and none at all at another. This method of dispersion no doubt implies the loss and destruction of a large number of young larvæ, but makes no extravagant call on one's faith in the travelling capacities of the young larvæ.

Another feature of the larvæ at Taormina was the number of alternative food-plants they affected—always, I think, where plenty of asphodel was near, but this may merely have appeared so from my not looking for them much elsewhere. The commonest of these was *Phlomis fruticosa*, on which the larvæ were so frequent and thriving, that I came to regard it as being but little less acceptable to them than the asphodel, and the moths bred therefrom are as fine as those from asphodel, notwithstanding that it was a less satisfactory food with which to supply the larva. There were frequently several on a shrub of *Phlomis*, but always solitarily, rolling up the leaves and fastening together the opening shoots in very ordinary tortrix manner, and eating down the central stem much as many tortrices do on shrubs and trees. Several larvæ were found doing well on *Teucrium fruticans*, on a very spinous *Cytisus* (much like the Riviera *Calycotome*), on an annual spinous woolly *Gnaphalium*-like composite that did not flower before we left Taormina, and on one species of thistle, and on one only, of several handsome species. This also I did not see in flower, but the leaves were, in texture, so like those of our common *Cnicus arvensis*, that I tried my homebred larvæ with the leaves of that pest of the farmer, and found that they seemed to prefer it almost to lupin. Lupin, by the way, the only alternative food-plant discovered at Hyères, was not found

attacked at Taormina, but then it was not observed except when cultivated.* Two larvæ were found on the unopened flower buds of a *Scilla?* (*Scilla sicula?*). As the plant was rarely seen (being inconspicuous till the flowers appear), it probably finds this plant of similar attractiveness to the asphodel.

Most curious of food-plants, I found two larvæ amongst those of *Acroclita consequana* collected from *Euphorbia*. At Capri the plants were a little more vigorous and succulent than at Taormina, but equally on open exposed slopes (top of cliffs near the sea), and, though their depredations were a little more visible than at Taormina, they might be described as having substantially the same habits as at Taormina. On April 20th some had already gone off full-fed to make their æstivating cocoons.

On April 15th at Paestum one larva only was found, with traces of perhaps a score of others that had already left full-fed. These larvæ also fed singly and cryptically, although the plants here (in the enclosures round the temples) were very large and vigorous, with leaves four feet or so long, and the flowers making a brave show. They were (counting empty domiciles as larvæ), however, exceedingly rare, having regard to the luxuriance and abundance of the plant, and in most places no traces of the larva could be found amongst great thickets of the plant.

About Albano, acres of the plant were looked over without seeing a trace of *H. hyerana*; looking to its rarity at Paestum and the difficulty of finding it there, I should hesitate to say that the moth is absent in the Roman district, and even if absent near Albano, it would probably be found to occur nearer the coast. I have, in fact, never met with it as far from the sea as Albano is.

I noted (E. M. M., *l. c.*) having reared certain larvæ to spinning up, from eggs laid by moths that emerged from my Hyères stock. These were two or three months in advance of their cousins of the same generation at large at Hyères, and spun up in January and February.

These emerged as moths during July and August 1905, their parents having emerged in the beginning of October. These presented hardly any typical pale forms, and might

* In captivity I tried the larvæ with the leaves of two cultivated species; they readily ate the broad fleshy leaflets of a white-flowered one, but refused the narrow curled ones of a kind with blue flowers.

be classified as 19 *marginata*, 4 *marginula*, 10 dark (black, not purple) *hyerana*. Their parents were a pale ♀ and a dark ♂ specimen. One or two of the *marginata* are of a very beautiful form, hardly represented amongst the parent brood, with a brilliant wash of gold round the margins of the wings. A number of these specimens were rather small, probably from some sort of starvation.

From a pair of these, both dark, and both very small, I obtained eggs on August 22nd.

It may be noted as regards dates that at the end of August the Sicilian moths were emerging, and on September 1st a pair of these laid some eggs. The Sicilian one I will, however, return to. The Hyères (3rd generation) larvæ spun up chiefly in November. On the 1st March, 1906, on looking at the box they were in I found 7 moths had emerged, all dark, and also all quite spoilt (two dead). I failed to obtain eggs from these. A ♂ (dark) emerged on the 4th, a pale ♀ on the 5th, and 2 dark specimens on the 15th. Unlike their parents, these were all of good size. The dark parentage did not therefore prevent a specimen of the type appearing. On March 15th the remaining cocoons contained 9 pupæ and 11 larvæ. I suppose this hastening forward, by which a brood occupies under ten months instead of twelve, is due to the warmer climate of my room, especially during the larval period. At Hyères I imagine the larval period is from October to April, about six months, in my boxes it takes about three.

I may note that the eggs laid by a Sicilian moth (all fertile) were counted as 1086.

I made several efforts to observe the duration of the pupa state, and have the following notes on the Sicilian race.

Pupated October 12 ;	emerged November 14 ♂
" " 13	" " 17 ♂
	(temperature 55°-70° ; average perhaps 63°)
Pupated December 23 ;	emerged February 2, 1906
" January 4	" " 12
" " 12	" " 19
" " 12	" " 22
" " 13	" " 22
" February 1	" March 10

14 pupated between Oct. 11 and 22 ; emerged Nov. 15, 15, 17, 18, 19, 19, 20, 22, 22, 22, 22, 28 (one missing).

14 pupated between Oct. 22 and Nov. 5 ; emerged Nov. 30, 30, Dec. 2, 5, 5, 7, 8, 8, 11, 12, 12, 16, 17, 23.

6 pupated Nov. 16-30 ; emerged Dec. 28, Jan. 1, 2, 2, 2, 5.

5 " Dec. 1-23 ; " Jan. 9, 10, 15, 17, 21.

It would appear that four to six weeks is therefore the duration of the pupal period.

The prolonged period during which the moths emerged is remarkable, and may be shown by the actual dates of emergence, or by a census of specimens still in larval state at different dates. All spun up within a week or two of the end of April 1905.

The first moths emerged August 26, 2 ; 27, 1.

September	1-16	14	} <i>i.e.</i> during		
"	17-30	41		August	3
October	1-14	30	}	September	55
"	14-31	22		October	52
November	1-30	24	}	November	24
December		19		December	19
January		11	}	January	11
February		3		February	3
March	10	1	}	March	1
April	13-29	2		April	2

When there still remained one pupa and one active larva.

A census of the asphodel feeders *only* from Taormina showed :

October	11	Emerged 69	Pupæ 40	Larvæ 56
"	22			" 40
November	15			" 21
"	30			" 15
December	23			" 9
January	4			" 6
"	13			" 3
"	22			" 1
March	20			" 2

The parasites from which *H. hyerana* suffered at Taormina differed entirely from its liability in this respect at Hyères. At Hyères it seemed quite immune, except from the attack of the larva of *Xanthandrus comtus*, a parasite in a broad sense, but not in the sense we usually mean in regard to insects, the larva of the fly hunting that of the

moth and demolishing it when caught, yet except this I found no larva suffered any attack whatever at Hyères. At Taormina, however, *X. comtus* was not met with as attacking *H. hyerana*, though it was not absent from the locality, being found living on the larvæ of *Acroclita consequana* in precisely the same way as it does at Hyères on that of *H. hyerana*.

This immunity from one attack, however, was well compensated by the attack of two Tachinid flies and of four Hymenopterous parasites. Mr. Wainwright tells me the commonest Dipteron is *Gymnopareia crassicornis*, apparently a widely-spread and common species. Why does this fly not attack it at Hyères, since no doubt it occurs there as over the rest of Europe, attacking as it does a great variety of the smaller Lepidoptera? A solitary specimen was also bred of a comparatively large Tachinid named as a var. of *G. crassicornis*, so large that one can only just suppose its host to afford it food enough, if it be one of the largest and fattest specimens.

The commonest Hymenopteron was a *Microgaster* near *subcompletus*, Nees., which spun a small white cocoon, each larva affording one parasite. This is very similar to (identical with?) one *Tortrix unicolorana* at Cannes and Hyères, where, however, it never touches *hyerana*. A number of *Bracon variegatus* were also bred, a species of *Ayathis* and a *Pteromalus* (names kindly supplied by Claude Morley, Esq.).

We must, I think, explain this remarkable difference in the parasites by the differences in the habits of the larva of *H. hyerana* at the two localities, and not by the presence or absence of the parasites or by any differences in their habits.

The moths selected for figuring (figs. 1 and 2) are a pair of the very pale form from Capri (var. *pallens*), to which the specimen from Paestum is very close, and to which a few odd specimens from Hyères make some approach. Figs. 3 and 4 are a pair selected from the Taormina specimens as fairly representing the mass of that race. It may also be taken as practically indistinguishable from the typical pale race at Hyères. Figs. 5 and 6 are a pair of the dark (melanic) form from Hyères (*marginata*, Wlsm.) (bred 1904). Figs. 7 and 8 are two forms of a variety occurring amongst the Taormina specimens. Whilst they are the nearest approach to a dark form that that race afforded, it

may be noted that nothing closely approaching them occurred amongst the Hyères race (ab. *nigro-punctata*). Figs. 9 and 10 are two varieties from Taormina, similar specimens were present in the Hyères specimens; 9 is probably Milliere's, ab. *alpha*; 10, a less extreme form of ab. *nigro-punctata* than 7 and 8. In both the Taormina and Hyères races a good many varieties in the extension of the spot occurred, several having more or less of an additional dark line above the one present in fig. 9. In other specimens, not otherwise especially pale, the spot tends to obsolescence, but almost invariably there remains at least one dark scale at this spot. I believe I have one specimen in which it is absolutely wanting on one side, but this is so rare that one does not like to be certain that the last single scale was not removed by some accident. Fig. 11 is an exceedingly rosy specimen from Hyères.

It is a very marked form of ab. *marginula*, to which also belong figs. 12 and 13, bred at Reigate (1905) from the egg. Fig 14, another of the same brood, is rather var. *marginata*, but is remarkable for its richness of colouring, and especially the golden suffusion round the margins of the wings. Figs. 12, 13 and 14 show the alliance of ab. *marginula* with var. *marginata* rather than with type *hyerana*.

Thirty specimens bred from eggs laid at Reigate by Taormina moths, varied less than those bred from larvæ collected at Taormina.

As regards the long period of emergence, may be noted a Hyères specimen that emerged June 4 from a larva collected only two months before, viz. in April 1906. I have met with no other example so precocious.

The whole of the specimens of *Hastula hyerana* referred to in this paper, have been added to the Walsingham collection of Micro-Lepidoptera in the Natural History Museum.

